

What is claimed is:

1. A medical diagnostic ultrasound system subsystem having its essential functionality largely residing in reprogrammable logic device components.

2. The diagnostic ultrasound system subsystem of claim 1, wherein the essential functionality mostly resides in reprogrammable logic device components.

3. The diagnostic ultrasound system subsystem of claim 1, wherein the essential functionality substantially resides in reprogrammable logic device components.

4. The diagnostic ultrasound system subsystem of claim 1, wherein the essential functionality about entirely resides in reprogrammable logic device components.

5. The diagnostic ultrasound system subsystem of claims 1, 2, 3, or 4, wherein the subsystem is a scan converter.

6. The diagnostic ultrasound system subsystem of claims 1, 2, 3, or 4, wherein the subsystem is a transmit beamformer.

7. The diagnostic ultrasound system subsystem of claims 1, 2, 3, or 4, wherein the subsystem is a receive beamformer.

8. The diagnostic ultrasound system subsystem of claims 1, 2, 3, or 4, wherein at least two subsystems comprise re-programmable logic devices.

9. The diagnostic ultrasound system subsystem of claim 8 wherein the at least two subsystems comprise a transmit beamformer, a receive beamformer, and a scan converter.

10. The diagnostic ultrasound system subsystem of claims 1, 2, 3, 4, 5, 6, 7, 8 or 9, wherein the diagnostic ultrasound system is portable.

5 11. A medical diagnostic ultrasound method for processing with a subsystem, the method comprising the acts of:

(a) processing data with at least one re-programmable logic device in the subsystem; and

(b) providing an essential functionality of the subsystem largely resident in the reprogrammable logic device components.

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12. The method of claim 11, wherein (b) comprises providing the essential functionality mostly resident in reprogrammable logic device components.

15 13. The method of claim 11, wherein (b) comprises providing the essential functionality substantially resident in reprogrammable logic device components.

14. The method of claim 11, wherein (b) comprises providing the essential functionality about entirely resident in reprogrammable logic device components.

20 15. The method of claims 11, 12, 13, or 14, wherein (a) comprises scan converting data.

16. The method of claims 11, 12, 13, or 14, wherein (a) comprises generating digital transmit waveforms.

25 17. The method of claims 11, 12, 13, or 14, wherein (a) comprises delaying and summing.

18. The method of claims 11, 12, 13, or 14, further comprising:

(c) performing (a) and (b) in at least two subsystems in an ultrasound data path of an ultrasound system.

19. The method of claims 11, 12, 13 or 14 further comprising:

(c) re-programming the re-programmable logic device in response to a change in mode.

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20. The subsystem of Claims 1, 2, 3 or 4 wherein the re-programmable logic device comprises a field programmable gate array.

21. A medical diagnostic ultrasound system for beamformation, the system comprising:  
a beamformer comprising at least one re-programmable logic device; and  
a transducer operatively connected with the beamformer.

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22. The system of Claim 21 wherein the beamformer comprises a transmit beamformer.

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23. The system of Claim 21 wherein the beamformer comprises a receive beamformer.

24. The system of Claim 21 wherein the re-programmable logic device comprises a field programmable gate array.

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25. The system of Claim 21 wherein an essential functionality of the beamformer resides in the re-programmable logic device.

26. A medical diagnostic ultrasound method for beamformation, the method comprising the steps of:

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(a) beamforming data with at least one re-programmable logic device; and

(b) transmitting data between the re-programmable logic device and a transducer.

27. The method of Claim 26 wherein (a) comprises generating digital transmit waveforms with the re-programmable logic device.

28. The method of Claim 26 wherein (a) comprises delaying and summing.

29. The method of Claim 26 wherein (a) comprises processing with a field programmable  
5 gate array.

30. The method of Claim 26 further comprising:

(c) providing an essential functionality of the beamformer resident in the re-programmable logic device.

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31. A medical diagnostic ultrasound system for scan conversion, the system comprising:  
a scan converter comprising at least one re-programmable logic device; and  
a display operatively connected with the scan converter.

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32. The system of Claim 31 wherein the re-programmable logic device comprises a field programmable gate array.

33. The system of Claim 31 wherein an essential functionality of the scan converter resides in the re-programmable logic device.

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34. A medical diagnostic ultrasound method for scan conversion, the method comprising the steps of:

- (a) scan converting data with at least one re-programmable logic device; and  
(b) transmitting data from the re-programmable logic device to a display.

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35. The method of Claim 34 wherein (a) comprises scan converting with a field programmable gate array.

36. The method of Claim 34 further comprising:

(c) providing an essential functionality of the scan converter resident in the re-programmable logic device.

37. A medical diagnostic ultrasound system for processing data, the system comprising:  
 5 an ultrasound data path; and  
 at least one re-programmable logic device operable to perform most of the digital processing within the ultrasound data path.

38. The system of Claim 37 wherein the ultrasound data path comprises at least one of a  
 10 transmit beamformer, a receive beamformer, an RF processor, a Doppler processor and a scan converter.

39. The system of Claim 38 wherein the ultrasound data path comprises at least two  
 15 devices of the group consisting of: the transmit beamformer, the receive beamformer, the RF processor, the Doppler processor and the scan converter, and wherein each of the at least two devices comprises at least one of the at least one re-programmable logic device.

40. The system of Claim 38 wherein the ultrasound data path comprises at least three  
 20 devices of the group consisting of: the transmit beamformer, the receive beamformer, the RF processor, the Doppler processor and the scan converter, and wherein each of the at least three devices comprises at least one re-programmable logic device.

41. The system of claim 38 wherein the ultrasound data path comprises each device of the  
 25 transmit beamformer, the receive beamformer, the rf processor, the doppler processor and the scan converter, and wherein each of the devices comprises at least one re-programmable logic device.

42. A medical diagnostic ultrasound method for processing data, the method comprising the acts of:

- (a) processing digital data in an ultrasound data path; and
- (b) performing most of (a) with at least one re-programmable logic device.

43. The method of Claim 42 wherein (a) comprises processing wherein the ultrasound data path comprises at least one of a transmit beamformer, a receive beamformer, an RF processor, a Doppler processor and a scan converter.

44. The method of Claim 43 wherein (a) comprises processing wherein the ultrasound data path comprises at least two devices of the group consisting of: the transmit beamformer, the receive beamformer, the RF processor, the Doppler processor and the scan converter, and wherein each of the at least two devices comprises at least one of the at least one re-programmable logic device.

45. The method of claim 43 wherein (a) comprises processing wherein the ultrasound data path comprises each device of the transmit beamformer, the receive beamformer, the rf processor, the doppler processor and the scan converter, and wherein each of the devices comprises at least one re-programmable logic device.

46. The system of Claim 23 wherein the one programmable logic device comprises a memory operable to delay received signals.

47. The system of Claim 28 wherein (a) comprises delaying received signals with a memory integrated with the one programmable logic device.

48. The system of Claims 1, 2, 3, or 4 further comprising an array of at least 64 elements.

49. The system of Claims 1, 2, 3 or 4 further comprising an array from the group consisting of: linear, curved linear, phased linear, sector and wide view array operatively connected with the system.

50. The system of Claims 1, 2, 3, or 4 wherein the re-programmable logic device components comprise less than three re-programmable logic devices in the subsystem.

5 51. The system of Claims 1, 2, 3, or 4 wherein the re-programmable logic device components comprise a single re-programmable logic device in the subsystem.

52. The method of Claims 11, 12, 13, or 14 further comprising:

(c) acquiring the data with an array of at least 64 elements.

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53. The method of Claims 11, 12, 13 or 14 further comprising:

(c) acquiring the data with an array from the group consisting of: linear, curved linear, phased linear, sector and wide view arrays.

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15 54. The method of Claims 11, 12, 13, or 14 wherein (b) comprises providing the essential functionality wherein the re-programmable logic device components comprise less than three re-programmable logic devices in the subsystem.

20 55. The method of Claims 11, 12, 13, or 14 wherein (b) comprises providing the essential functionality wherein the re-programmable logic device components comprise a single re-programmable logic device in the subsystem.

56. The system of Claim 21 wherein the transducer comprises an array of at least 64 elements.

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57. The system of Claim 21 wherein the transducer comprises an array from the group consisting of: linear, curved linear, phased linear, sector and wide view arrays.

58. The system of Claim 21 wherein the at least one re-programmable logic device comprises less than three re-programmable logic devices.

59. The system of Claim 21 wherein the at least one re-programmable logic device comprises a single re-programmable logic device.

60. The method of Claim 26 further comprising:

(c) transmitting acoustic energy wherein the transducer comprises an array of at least 64 elements.

61. The method of Claim 26 wherein (b) comprises transmitting data for the transducer comprising an array from the group consisting of: linear, curved linear, phased linear, sector and wide view arrays.

62. The method of Claim 26 wherein (a) comprises beamforming wherein the at least one re-programmable logic device comprises less than three re-programmable logic devices.

63. The method of Claim 26 wherein (a) comprises beamforming wherein the at least one re-programmable logic device comprises a single re-programmable logic device.

64. The system of Claim 31 wherein the at least one re-programmable logic device comprises less than three re-programmable logic devices.

65. The system of Claim 31 wherein the at least one re-programmable logic device comprises a single re-programmable logic device.

66. The method of Claim 34 wherein (a) comprises scan converting wherein the at least one re-programmable logic device comprises less than three re-programmable logic devices.



67. The method of Claim 34 wherein (a) comprises scan converting wherein the at least one re-programmable logic device comprises a single re-programmable logic device.

68. The system of Claims 37, 38, 39, 40 or 41 further comprising a transducer having an array of at least 64 elements, the transducer operatively connected with the ultrasound data path.

69. The system of Claims 37, 38, 39, 40 or 41 further comprising a transducer having an array from the group consisting of: linear, curved linear, phased linear, sector and wide view arrays operatively connected with the ultrasound data path.

70. The system of Claims 37, 38, 39, 40 or 41 wherein the at least one re-programmable logic device comprises less than three re-programmable logic devices.

72. The system of Claims 37, 38, 39, 40 or 41 wherein the at least one re-programmable logic device comprises a single re-programmable logic device.

73. The method of Claim 43 wherein (a) comprises processing wherein the ultrasound data path comprises at least three devices of the group consisting of: the transmit beamformer, the receive beamformer, the RF processor, the Doppler processor and the scan converter, and wherein each of the at least three devices comprises at least one re-programmable logic device.

74. The method of Claims 42, 43, 44, 45 or 73 further comprising:

(c) transmitting acoustic energy corresponding to the digital data wherein a transducer comprises an array of at least 64 elements.

75. The method of Claims 42, 43, 44, 45 or 73 further comprising:

(c) transmitting acoustic energy corresponding to the digital data wherein a transducer comprises an array from the group consisting of: linear, curved linear, phased linear, sector and wide view arrays.

5 76. The method of Claims 42, 43, 44, 45 or 73 wherein the at least one re-programmable logic device comprises less than three re-programmable logic devices.

77. The method of Claims 42, 43, 44, 45 or 73 wherein the at least one re-programmable logic device comprises a single re-programmable logic device.

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